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THESIS

Lease versus Buy Decision
Methodology for the Korean Army:
A Proposal

by

Kim, Il Joong

March, 1990

Thesis Advisor:

Joseph G. San Miguel

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Lease versus Buy Decision
Methodology for the Korean Army:
A Proposal

by

Kim, Il Joong
Captain, the Korean Army
B.S., Korea Military Academy

Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

The Korean Army currently does not have a prescribed methodology to evaluate the lease versus buy alternatives for financing items procured from private industry. This study provides a general analysis of the Korean Army's lease versus buy decision methodology, especially computer hardware systems. It provides background information on lease versus buy decisions in both the public and private sectors. It also examines a specific example of lease versus buy decision analysis in public sector.

However, the analysis shows that cost considerations do not always receive top priority. Military policies, technical sophistications, maintenance, and discount rate are among the other factors considered in lease versus buy analysis.

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I. INTRODUCTION

Leasing capital assets in the public sector is a recent development. More importantly, leasing has started as a financing method in the Republic of Korean Army as leases in commercial sector in Korea increased. The lease history of the Korean Army is very short.

In 1984, the Korean Army began using the lease transaction to gain the services of a computer network for high level (division or higher) units, namely a DPS-6 mainframe which has a total system cost of approximately \$5 million dollars. That was the first and largest operating lease in The Korean Army. But, more and more leases are expected in the Korean Army for system acquisition. Purchasing system has high initial costs, and the leasing of highly technical equipment is easier than buying in maintenance.

As a result, financial managers of the Korean Army are confronted with the lease-or-buy issue. The Korean Army currently does not have an explicit uniform methodology to select between the lease versus buy financing for items procured from private industry. It may be rather difficult, however, to resolve this issue since there is multitude of lease-or-buying models that vary widely in assumed initial conditions, form, and content.

A. OBJECTIVE

The underlying purpose of this thesis is to examine and analyze a lease versus buy methodology used by the U.S. Armed Forces, and to address the application of U.S. military policies to the Korean Army. The specific goal is to provide the Korean Army

manager with an objective guideline to maximize the efficiency of his budget in a lease versus buying situation.

The subsidiary objectives of this study are several fold. First, it is designed to provide the reader with a review of the structure and the financial and tax accounting requirements for leases in general. As a part of that review, the trade-offs of lease versus buy will be discussed.

Second, it will present the general factors for and against leasing and buying, including technical performance, managerial aspects and financial conditions. The financial area will be discussed more precisely.

Third, this study will examine current practices, lease versus buy models, and elements of the lease versus buying decision in the public sector.

Finally, this thesis will present a framework of lease versus buying decision methodology for the Korean Army with some of the important lessons learned from examples of U.S. Armed Forces.

B. ORGANIZATION

This thesis is arranged into chapters, each having specific objectives. Chapter Two provides a general overview of the lease versus buying discussion. The lease-buy decision, financial and tax accounting treatment of leases, the leveraged lease, tax-exempt lease, and the trade-offs of lease-buy are all discussed to provide a foundation.

Chapter Three deals with three basic general factors against leasing and buying which decision makers take into consideration in making an effective and best decision: technical, managerial and financial aspects.

Chapter Four examines the specific lease versus buy decision models presently used by the public sector.

Chapter Five presents the application/implication of lease versus buying methodology in the Korean Army. It includes a general model for potential application and several factors to be considered. And it presents conclusions with the lessons and recommendations of this thesis.

II. BACKGROUND

In order to understand the basic issues surrounding the lease versus buy decision, a foundation of information is required. This chapter will review the general nature of leasing and review the rules and regulations which govern the financial and tax accounting for leases.

A. THE LEASE-BUY DECISION

The decision to lease or buy an asset is a secondary consideration in the capital budgeting process. Contemporary finance theory adheres to the principal that the attractiveness of any capital investment opportunity should be appraised without reference to the type of financing which will be used to gain the use of that asset. In that regard, the critical question is whether an entity should lease or buy an asset in the first place. Once the decision has been made to invest in a capital asset, then the entity is ready to address the question of how to finance the acquisition of that asset. [Ref.1: p.815-823]

When faced with the question of how to acquire an asset, the decision-maker can make one of two basic choices: buy the asset or lease it. To make that decision, several factors must be considered, the most important of which include: [Ref.2: p.41-49]

1. The ability of the entity to raise funds to buy the asset. Entities in the private sector must consider the availability of equity and debt capital. Public sector entities must access their ability to obtain procurement appropriations from the authorizing body.

2. The total relative costs of buying versus leasing must be compared. Since there are different cash flows associated with each alternatives, some meaningful method of comparison must be used.

3. The impact of the method of acquiring the asset on the entity's financial statements must be assessed. Purchase of the asset requires disclosure of any liability incurred in its purchase. Leasing, on the other hand, can be "off-balance sheet" financing and no such liability is disclosed.

4. The risks and cost inherent in the buy and lease alternatives. Obsolescence, for instance, may be a major concern which makes the lease alternative more attractive than a purchase.

5. The availability of tax benefits is usually a major advantage to buying. However, some entities, including start-up firms, non-profit firms, and government agencies cannot take advantage of the tax benefits of ownership. In some cases, a lessor can capture these benefits and pass some of them to the lessee in the form of lower lease payments. The ability to use the tax benefits inherent in ownership is a major consideration which may favor the lease alternative.

6. The selection of an appropriate cost comparison methodology that takes into account all of the pertinent elements, in addition to those listed above, involved in the lease versus buy decision is a critical task.

The process of selecting the financing alternative to acquire an asset encompasses several criteria which require managerial judgement as well as quantitative analysis. The lease and buy alternatives are, in themselves, a system of complex decisions. The decision to buy is often a decision to "borrow" since few companies are able, or find it to their advantage, to fund capital investments purely from equity sources. The lease

alternative is even more complex to decipher because there are so many facets to be considered when structuring a lease. In summary, the decision to lease or buy is not an investment decision, rather it is a financing decision.

B. LEASE IN GENERAL

A lease is an agreement between two parties: a lessor who owns an asset and a lessee who uses the asset. The lease agreement conveys to the lessee the right to use an asset owned by the lessor for a specific period of time in return for a stipulated series of cash payments. This series of cash payments is set to enable the lessor to recover the cost incurred to procure the asset, arrange the lease, and provide a satisfactory rate of return on the investment in the asset over the life of the lease. Title to the leased asset is retained by the lessor. At the end of the lease term, the lessee usually has three options: (1) renew the lease, (2) buy the asset, or (3) terminate the lease and return the asset to the lessor. The terms under which the lessee can exercise any of the three options determine the classification of the lease for tax purposes as well as for financial accounting purposes.

Leases are classified from two different perspectives. From an **accounting standpoint**, leases are classified as either capital leases or operating leases. The accounting distinction between a capital and operating lease is further dependent upon whether it is the lessor or the lessee who is accounting for the lease. From an **Internal Revenue Service Standpoint**, leases are classified as either true leases or conditional sale leases. The principal financial benefit of lower acquisition cost, commonly attributed to leasing, is dependent upon the lease being classified by the IRS as a true lease. Classification as a true lease permits the indirect realization of tax benefits which

might otherwise be lost. The true lease enables the lessor to claim the tax benefits of ownership and pass through to the lessee some of those benefits in the form a reduced rentals.

Classification as a conditional sales lease, however, recognizes the lessee as the owner for tax purposes. The lessor is unable to recognize any tax benefits and cannot charge a lease rate which is competitive with a purchase financed using conventional borrowing. Classification as a conditional sale lease is generally unacceptable for both the lessor and lessee. The criteria for the classification of leases from both an accounting standpoint and an income tax standpoint are presented below. [Ref.3]

C. FINANCIAL ACCOUNTING FOR LEASE

1. Lessee

From the lessee's standpoint, a lease is classified as either a capital (financing) lease or as an operating lease. The capital lease provides the lessee with most of the benefits and responsibilities of ownership except for legal title and any benefits from the asset's residual value at the end of the lease term. Significantly, the capital lease requires the lessee to carry the asset on its balance sheet both as an asset and as a liability at the present value of the unpaid lease payments. Classification of the lease as an operating lease, on the other hand, provides for the temporary use of the asset without the lessee assuming any ownership rights or risks. As a result, no balance sheet entries are required to record acquisition of the asset. For that reason, operating leases are referred to as "off balance sheet financing". [Ref.4: p.979-986]

For the lessee, the lease must be classified as a capital lease if it meets one or more of following criteria: [Ref.5: p.10-11]

1. Lease transfers ownership of the asset to the lessee.
2. Lease contains a bargain purchase option.
3. Lease term is equal to or greater than 75% of the estimated economic life of the leased asset.
4. Present Value of the minimum lease payments equals or exceeds 90% of the fair value of the leased asset.

2. The Lessor

For the lessor, leases are classified in one of three ways:

1. Operating lease,
2. Direct financing lease, or
3. Sales type lease.

The lease must be classified as a direct financing lease or as a sales type lease if the lease meets any one of the four criteria needed to be classified as a capital lease for the lessee, and meets both of the following criteria:

1. Collectibility of the lease payments from the lessee is reasonably predictable.
2. No important uncertainties exist over the unreimbursable costs yet to be incurred by the lessor under the lease.

The difference in classification between the direct financing lease and the sales-type lease exists in the presence or absence of a manufacturer's or dealer's profit. A sales-type lease involves a profit or loss while a direct financing lease does not. Determination between the two is made at the inception of the lease when the fair market value of the asset is compared with the lessor's cost. If fair market value and cost are different, the lease is classified as a sales-type lease. If fair market value and lessor's cost are the same, the lease is classified as a direct financing lease. If the lease is unable to meet direct financing or sales criteria, it must be classified as an operating lease. [Ref.4: p.979-986]

expense, but does not have to recognize future lease payments as a liability on the balance sheet.

The conditional sale lease, however, considers the lease agreement to be a disguised sale and recognizes the lessee as owner of the asset. The lessor must treat the transaction as a loan. Since the lessor is not entitled to any of the tax benefits of ownership, the lessor must charge higher lease rates to recover his costs. The lessee must carry the asset on the balance sheet as both an asset and a liability, which may be unacceptable from the lessee's standpoint.

The criteria, which govern classification as a true lease or as a conditional sale lease, are set forth in various IRS Revenue Rulings and Procedures. In making that determination, the IRS stated that it would examine the leasing agreement in terms of its intent and in light of the facts and circumstances at the time of the agreement. The IRS explained that no single test or combination of tests would be used in making its rulings, but rather each case would be decided in the light of its particular facts. [Ref. 6]

While the tax laws which surround leases are lengthy and complex, a lease generally qualifies as a true lease for tax purposes if all the following criteria are met.

1. The estimated fair market residual value of the leased property at the end of lease term must equal or exceed 20% of the original cost of the leased property.
2. The estimated remaining useful life of the leased property at the end of the initial lease term will equal or exceed 20% of the original estimated useful life of the leased property and be at least one year.
3. The lessee must not be entitled to purchase or re-lease the property at the end of the lease term at a bargain (below fair market value) price, nor may the lessor be permitted to abandon the property at the end of the lease term.

Classification as a direct financing lease permits the lessor to recognize income from the lease by amortizing unearned income over the lease term so as to produce a constant periodic return on the net lease investment. Classification as a sales type lease would lead to the lease being classified as a "pseudo" or conditional sale lease which would prohibit the lessor from taking advantage of the tax benefits inherent in ownership.

If the lease agreement fails to meet the criteria for classification as either a direct financing lease or as a sales type lease, it must be classified as an operating lease, which requires the lessor to report income over the lease term as lease payments become receivable. The deferral of income which results from classification as an operating lease usually makes such classification unacceptable to the lessor. For the lessor, structuring the lease to insure its classification as a direct financing lease is critical since it permits the lease to be further classified as a **true lease** for tax purposes, thereby qualifying for various tax benefits. [Ref.3]

D. TAX ACCOUNTING FOR LEASES

Apart from the financial accounting requirements for lease classification, the IRS has established its own standards of classification to address the income tax ramifications of leasing agreements. In the eyes of the IRS, leases are classified as either a **True lease** or as a **Conditional Sale lease**. The true lease recognizes the lessor as the owner of the leased assets, which entitles the lessor to the tax benefits associated with ownership. These tax benefits are important to both the lessor and lessee because they effectively lower the lessor's cost of acquisition which permits the lessor to charge lower lease rates. The lessee recognizes the lease payments on the income statement as an

4. At the beginning of the lease and all times during the lease term, the lessor must have a minimum unconditional at risk investment equal to at least 20% of the cost of the leased property.

5. The lessee or any related party may not provide any part of the cost of the property, nor can they lend to the lessor any of the funds necessary to acquire the property or guarantee any indebtedness incurred in connection with the acquisition of the property.

6. The lessor must demonstrate that it expects to receive a profit from the leasing transaction which is apart from any tax benefits resulting from the lease. [Ref. 7]

E. LEASING AND TAX INDEMNITIES

As discussed above, the use of leasing as a means of financing is normally predicated upon the availability of tax benefits for the lessor. The lease rate is set at a level which, in conjunction with the tax benefits realized, enable the lessor to recover the cost of acquisition and provide an acceptable rate of return on the investment. The lessor regards its risk as a lending risk and not a speculative risk associated with the availability of tax benefits. The lease agreement is normally written to protect the lessor against the loss of expected tax benefits. If the tax benefits are determined to be unavailable to the lessor, the lease rate is adjusted upward to offset any loss which the lessor would incur as a result of that determination. Such tax indemnification is defended under the premise that since the lessor passes a substantial part of the tax benefits on to the lessee in the form of reduced lease rates, which represents a substantial reduction in the cost of long term debt financing, the lessee should accept its share of the risk. [Ref.8: p.55-96]

F. THE LEVERAGED LEASE

Direct financing (true) leases fall into two basic categories: direct leases and leveraged leases. In a direct lease, the lessor provides all the funds necessary to acquire the asset which will be leased. If the lessor borrows to acquire the necessary funds, he does so on a full recourse basis. In other words, the lessor is at risk for all the funds necessary to acquire the asset.

The leveraged lease has evolved over time from the basic financial lease as the financing profession has sought to take advantage of the tax benefits of ownership without incurring the total costs usually associated with such ownership. Basically, the leveraged lease is a third-party financial leasing agreement in which the lessor borrows, from a third party lender on a non-recourse basis, a substantial proportion (usually 50% to 80%) of the purchase price of the asset to be leased. The loan is secured by a first lien on the asset, an agreement of the lease, and an assignment of the lease rental payments. The interest rate charged on the non-recourse loan is a function of the lessee's credit rating. [Ref.8: p.55-96]

The lessor then leases the asset to the lessee for a stipulated series of lease payments. The combination of the cash flows from the lease payments and the savings realized from the tax benefits associated with owning the asset provide the lessor with the necessary rate of return on his investment. [Ref.9: p.15-23]

The leveraged lease is a highly complex financial investment in two respects: First, it is legally complex in that it depends on tax laws, specific tax rulings and complicated trust and security agreements. Second, the leveraged lease is computationally complex in that the dollar amounts of the lease payments are dependent upon several factors. [Ref.10: p.20-27]

The most important tax issue inherent in the leveraged lease is the whether the IRS will rule that the lease qualifies as a true lease and is eligible to provide the lessor with the anticipated tax benefits. If the IRS rules that the leveraged lease does not qualify as a true lease, but is instead a "conditional sales" agreement, then the lessor will lose the tax benefits to the lessee. In such cases, the lease agreement will usually require the lessee to pay a higher periodic lease payment to compensate the lessor for the loss of the anticipated tax benefits in order to maintain the lessor's required rate of return.

In 1981, the Economic Recovery Tax Act (ERTA) significantly relaxed the conditions under which a lease agreement would be considered a "true" lease by the IRS. Prior to ERTA, the major consideration in determining whether a lease qualified as a true lease was whether it had nontax economic substance. Toward that end, two specific requirements were imposed: [Ref.11: p.241-255]

1. The lessor was required to make and maintain a minimum unconditional equity investment of at least 20% of the cost of the asset.
2. There must exist a reasonable expectation of profit from the transaction, independent of the tax benefits.

The passage of ERTA in 1981 essentially repealed the requirements that leases have nontax economic substance in an attempt to increase the profitability of struggling businesses by offering them incentives to purchase new equipment and machinery. These provisions permitted these companies to sell their tax benefits resulting from new purchases by entering into sales-leaseback transactions with profitable companies. For lessor companies, these relaxed rules offered attractive rates of return through the purchase of the tax benefits of unprofitable companies. While the ERTA provisions proved to be extremely popular with the business community, the cost was seen to be prohibitive by the Treasury and the ERTA provisions were changed in 1982 by the Tax

Equity and Fiscal Responsibility Act (TEFRA). TEFRA restricted the benefits ensuing from various leasing transactions. Significantly, TEFRA reinstituted the pre-ERTA nontax economic substance requirements for leveraged leases. [Ref.11: p. 241-255]

G. TAX EXEMPT LEASING

Any acquisition of an asset can be viewed as a combination of interrelated costs, benefits and risks which are allocated among the owners, users and financiers associated with the transaction. Among these costs and benefits are state and Federal income taxes associated with the financing arrangements of the transaction. Government agencies (Federal, state and local) are, by and large, exempt from paying taxes and are likewise not able to take advantages of various tax benefits accruing from ownership, such as depreciation deductions and deductions for interest paid on debt instruments. Leasing transactions, however, can be structured so that the tax exempt entity can enjoy the tax benefits it is normally prohibited from using. One such method is to structure the transaction in such a way as to provide the lessor with the tax benefits accruing from ownership (investment tax credits, interest and depreciation deductions). The lessor, in turn, passes some of those benefits back to the tax-exempt entity in the form of lower payments than it would normally incur if it were to acquire the asset through some other conventional debt financing arrangement. [Ref.12: p.232-240]

Tax-exempt leasing has come under a great deal of scrutiny from Congress. The largest reason for congressional concern is the negative impact leasing by nontaxable entities has on tax revenues. When a nontaxable entity structures a lease in a way which generates tax benefits and lowers the lessor's tax liability, the Federal Treasury, in effect, subsidizes the acquisition of that asset. So, although a nontaxable entity (such as Federal

agency) may pay a lower price for its acquisition, the total cost to the government may actually be more than if the entity had purchased the asset instead of leasing it. [Ref.13]

H. LEASE VERSUS BUY: ADVANTAGES AND DISADVANTAGES

Leases have some practical advantages to many companies, especially small and start-up companies. In leasing, cash flow requirements can be easily predicted due to fixed monthly payments. Leases typically require no down payment and collateral, so that it reduces the up-front cash requirements. Another advantage of leasing is that it is more flexible than borrowing. Leases are considered operating expenses rather than capital expenses. Operating expenses are typically easier to authorize than capital expenses. This flexibility is attractive, even for the large companies. As Mr. Brooks WALKER Jr., Chairman of U.S. Leasing, states "In many big companies and in government, the capital appropriations process is so complex that any change, especially in the middle of a year, is very difficult. Leasing is a way to get around that." [Ref.14: p.150]

The ability to shift tax benefits is another potential advantage that received a great deal of attention prior to 1986. Sometimes, small or start-up firms can not take advantage of the tax benefits, including accelerated depreciation and investment tax credit, associated with capital ownership. This creates an opportunity for a company that can utilize the tax benefits to purchase the asset and lease it to the interested firm. If the lessor passes on a portion of the tax benefits can be to the advantage of both parties. [Ref.15]

Leasing also has some disadvantages. Sometimes reduced lease payments might not be as valuable as the lost tax benefits, as often happens when a firm has a large tax liability. Another disadvantage is that the lessee loses ownership of the system. As

a result, the lessee sacrifices management control over system operation. Finally lease agreements typically require that system operational specifications be specified well in advance of system operation. This reduces technical flexibility in responding to changes in demand or other conditions during the lease period. [Ref.16: p.10]

III. FACTORS CONSIDERED IN A LEASE-BUY ANALYSIS

There are several important factors which should be considered in lease versus buy decisions. These include technical aspects related to technical requirements and management aspects related to the cost and decision-making responsibilities associated with managerial control. Finally, there are financial aspects and variables related to both funding and cost factors, including key variables in lease negotiation.

A. TECHNICAL ASPECTS

Technical aspects in lease versus buy decisions for both the private sector and government sector are an important matter which requires precise work and good planning. Capital assets have life spans that extend over several years, which raises issues of an asset's useful life and lease life. This is reflected in the duration of most leasing contracts and is even more evident when the asset is purchased. That is why both government and private sectors have to know their objectives and their requirements. This is complicated because technology and the requirements change over time. [Ref.16: p.14]

A typical example is a lease versus buy analysis for a satellite communications system in the U.S. Navy. The technical considerations in a lease versus buy decision for this system involve the technical requirements and the risks related to them. For the lease situation, satellite communication system requirements are stated in terms of **service** and **performance**. According to the lease strategy, the design is "frozen" at the time of contract award in order to have the program run smoothly. [Ref.17: p.27] Because of the inflexible specifications, the system contractor may get some important savings in

optimizing design and construction. However, this places most of the risk of technical uncertainty on the lessor, rather than the government. This makes leasing less appropriate when technical uncertainties are significant.

In the buy alternative, requirements are stated in terms of **design** specifications rather than **performance** specifications. There are two aspects to flexibility, **construction** flexibilities from the contractor's point of view and **management** flexibilities from the buyer's point of view. Design specifications are generally more flexible from the buyer's perspective. The contractor has to design the system to meet whatever requirements are set by the buyer. With a lease, performance specifications are typically set early in the design process. This gives the contractor construction flexibility in designing the system to meet the performance specifications, but it limits the buyer's management flexibility in changing those specifications. On the other hand, in the buy option, design specifications limit the contractor's construction flexibility. However, design specifications have flexibility so that they may be changed to accommodate changing requirements as the technology changes. This causes a series of re-approval phases. As a result, high costs and delayed programs are more prevalent when the government buys a system than when the system is leased. Furthermore, the government bears the risk of technical uncertainty in a purchased system. [Ref.17: p. 28]

The technical evaluation in lease versus buy decisions must balance the relative **strengths** and **weaknesses** of the purchase and the lease alternatives. Leases provide the contractor with more flexibility in designing the system but reduce the lessee's flexibility because the design is frozen. However, design specifications generally result in a more smoothly running program with fewer delays. In the buy alternative, technical requirements are more flexible but this can result in more delays and higher costs. The

appropriate balance will depend on the uncertainty of future requirements and performance improvements, and on the level of technical uncertainty. [Ref.17: p.28]

B. MANAGERIAL ASPECTS

Managerial aspects are also important and can not be separated from financial and technical aspects. Managerial aspects during system planning and construction are affected by the lease versus buy decision, because a lease is based on performance specifications rather than design specifications. A lease requires less administrative and management effort because it doesn't require review in Planning, Programming and Budgeting System (PPBS). Thus, management overhead for the government will be lower, both in the administrative and planning phases of the program. The manufacturer and lessor are responsible for management to meet the performance requirements once they are determined and agreed on in a contract. This lessening management overhead corresponds to the inflexibility of the design. [Ref.17: p.29]

Other management considerations are observed in contract negotiations which characterize both leasing contracts and purchase contracts. These management considerations concern: the type of contract(fixed price, cost plus fixed fee, or some combination of the two), the payment and the period of the lease contract. Another important management issue is to determine satisfactory and unsatisfactory performance of the system. [Ref.17: p.30]

Managerial aspects are simply treated as the trade-off between managerial control and the costs related to such control. In a lease option, governments have lower management costs since the number of personnel assigned is small and the administrative costs related to top management levels are low. In return, however, the government

sacrifices management control. In the case of purchase, managerial and administrative costs are higher than in lease option, but the government has greater management control. The proper balance depends on the trade-off between managerial costs and the importance of managerial control. [Ref.17: p.30]

C. FINANCIAL ASPECTS

1. Key Variables in Lease-Buy Negotiation

a. Discount Rate

A major factor in the lease versus buy decision is the timing of the costs and benefits in the cash flow. Typically, purchasing requires the immediate incurrence of a one time initial cost whereas leasing involves a series of smaller periodic costs which are greater than the one-time cost of the purchase decision. The time difference cannot be merely assumed and compared because to do so would imply that money has equal value regardless of the timing of its receipt. If this were the case, purchasing would clearly be the choice over lease in all situations, assuming no taxes.

It is important to determine the opportunity cost of the money involved in the lease versus buy transaction because the time value of money makes a difference to the decision maker. In each decision, the analyst must determine both the category and magnitude of costs to be incurred and the time period over which those cost will be incurred. Two cost streams are developed, one representing the buy decision and the other representing the lease decision. In order to compare these streams, a single value must be ascertained at a certain point in time - usually that point in time that the lease versus buy decision will be made. This procedure is known as calculating the present value of the costs or discounting the costs. The present value of each cost is summed

according to the stream in which that cost occurs. The result is the total present value costs of the lease stream and buy stream.

When the calculations are performed, the discount rate should be that value which best reflects the time value of money of the decision-maker performing the analysis. The result will indicate that the present value of a future cost will be smaller as the time period of the investment is increased, assuming the discount rate is held constant. Also of interest is the fact that as the discount rate is increased, the discounted cost of the investment will be smaller, assuming a fixed period of time. Discount tables are available in most economic and accounting texts. [Ref.18: p.42-45]

The previous discussion is only a basic illustrative framework for calculating the necessary cost streams in the lease versus buy decisions. The actual opportunity cost used by government is more difficult and complex to obtain than the industry rate. The problem of choosing a discount rate to use in evaluating government projects arises are follows:

Consider a government project that promises to pay benefits B_t in periods $t = 1, \dots, T$, and incur costs C_t in periods $t = 1, \dots, T$. How does one go about comparing costs and benefits that occur in different periods, and what rule should be used in determining whether the project is worthwhile undertaking? The standard approach in economics is to introduce a discount rate r , the government discount rate, and to use this discount rate in determining the present value of the benefits (PVB) and costs (PVC) of the project. The present value of benefits is given by

$$PVB = \sum_{t=1}^T \frac{B_t}{(1+r)^t}$$

while the present value of costs is

$$PVC = \sum_{t=1}^T C_t(1+r)^{-t}$$

A government project is then regarded as worth undertaking if, and only if, PVB is greater than PVC-that is, the present value of net benefits from the project is positive.

There are, however, several sticky things to consider in this problem. First, Why are future costs and benefits discounted in calculating the present value of net benefits? The economist's answer is basically an application of the notion of opportunity cost. But, it is very difficult to apply a opportunity cost in both public and private sector because of calculating the positive or negative of discounted net benefits. Another issue should be disposed of before we proceed any further. It might be asked whether the use of an aggregated measure such as discounted net benefits leads to a loss of information relevant for decision-making, compared the original vector of benefits and costs, dated by period. The answer is that so long as costs and benefits are correctly measured, and so long as the correct government rate of discount is used in the calculation, a positive value for discounted net benefits is equivalent to the assertion that the social welfare is increased.

Needless to say, there are many complicated problems involved in correctly calculating benefits and costs, and in identifying the correct value of the government rate of discount largely, because it depends on lots of factors such as a perfectly competitive economy operating under certainty or uncertainty, monopoly economy, market power, market failure, and government regulations, rules, etc. [Ref.19: p.15-16]

In practice the DOD has been mandated to recognize the time of cash-flows by using discounting techniques. An overall rate of ten percent has been stated as a rate which reflects the preference for current and future money sacrifices that the public exhibits in non-government transactions. This prescribed rate is supposed to represent an estimate of the average rate of return on private investment before corporate taxes and after adjusting for inflation.[Ref.20: p.6-7]

In the Korean Army case, there is no mandated unique rate of discounting. This is changed at every project in every market. One important thing is that every contract by government is profitable and advantageous to government with private sector in calculating the rate of discount.

b. Terminal Value

The lease is a contract which separates the possibility to use the property from its ownership for the period of the lease. One argument favoring ownership over leasing is that the value that will exist at the end of a lease contract is too great to surrender. For example, real estate is a certain type of property that usually enjoys a high sale value at the time the lease expires. On the contrary, goods that change technically very fast are the other cases. [Ref.21: p.426]

In many situations, the possibility of substantial end of life capital value can be overlooked by decision-makers in the lease versus buy appraisal. The following factors can support this omission.

1. Economic life is frequently so long and ultimate dollar realization so far distance that these future values have very little effect on present investment decisions.
2. The probable residual is sometimes so low that it can safely be ignored.

3. The available data on the asset to be considered for use does not provide an adequate base for forecasting.

4. The future is so uncertain that changing conditions may wipe out whatever values seem probable once the economic decision has been made. [Ref.22: p.259-268]

Residual values or terminal values have more meaning than the term salvage value implies. Terminal values include everything that produces or retains a cash or opportunity cost value at the time the physical facilities contemplated in the lease versus buy proposal are retired or replaced. The value is usually positive in amount but sometimes may be negative.

The following propositions were proposed regarding terminal value, economic life, tax life, and/or annual earnings. [Ref.22: p.259-268]

1. If the tax writeoff is in line with the life time decline in the resale value of the original investment, residual values have little effect on rate of return.

2. If those two variables are not in line, residual values can have a major influence on the investment decision, provided that economic life is short and/or the minimum discount rate is low.

3. When economic life is long (e.g., ten years or longer) and the company's minimum discount rate is high (e.g., 20% or higher), the effect of the residual value on the investment decision is likely to be limited to borderline projects.

4. When economic life is short and/or when the minimum discount rate is low, residual values will have a broader range of influence, and estimates should be made.

5. When the minimum discount rate is high and economic life is long, the rate and level of the tax writeoff has a far greater impact on investment worth than the residual value.

From the above mentioned points, it behooves the lease contracting parties to write their contracts with a decision that examines an allowance for a terminal value which could alter the required lease payments in favor of the lessee. Thus, careful negotiations of the terms of a lease can overcome the disadvantage of loss of title, unless major capital gains are very certain.

Estimating terminal values is a very difficult task, but if terminal values are deemed influential in the investment decision, the task must be addressed. The most frequent excuse in disregarding terminal value is that adequate data is not available. It is true that many firms do not have routine reporting systems in which a flow of data is in a readily usable form. Also of consideration is the fact that many estimates can not be based completely on data that is produced as a by-product of the normal historical record of transactions. However, estimates should be made although it is generally understood that precision will not be achieved. To be remembered here is that great precision is not necessary because fairly substantial error ranges in the estimates of terminal values can be tolerated because of the effect of time on present value in lease versus buy decision.

Although historical data can be used, the decision maker must be forward-looking. The relevance to the future must be evaluated. Past accounting records are generally most useful in estimating the resale values of plant and equipment. For example, each piece of equipment gives rise to a set of information relative to resale price and removal. Thus, this type of flow of information can be systematized to lay the foundation for future estimates. Of interest to the decision maker are firm and quasi public sources which specialize in surveys of asset terminal values. In some cases

terminal value curves can be derived from some of the currently available published special surveys. [Ref.22: p.259-268]

c. Some Legal Variables

A lease not only is a credit instrument but must comply with the relevant tax and account guidelines, the common law, securities, etc. So there are many legal factors to be considered. In lease versus buy decision, tax factors, types of leases, amount and timing of rental payment, disclaimer of warranties, etc. should be checked before. [Ref.23: p.34-35]

2. Frameworks of Lease versus Buy Analysis

a. Widely Accepted Models

Paul F. Anderson and John D. Martin conducted a survey of the top Fortune 200 firms in order to determine the methods used in a lease versus buy decision. The survey indicated that the companies depended on the traditional internal rate of return (IRR) model, the conventional net present value (NPV) model, a variant to the Weston and Brigham model, and a variant to the Bower, Herringer, and Williamson model. [Ref.24: p.41-47]

As the survey findings, 70% of the firms used the IRR model and NPV model, and the remaining respondents used variations of the Weston and Brigham model and Bower, Herringer, and Williamson model.

Before examining these different models, note the following notation and their meaning.

A_0 = cash purchase price of the asset.

R_i = lease payment required in year i .

D_i = depreciation charge for year i allowed for tax purposes.

I_i = interest on a loan or loan equivalent in year i .

I_i' = Bower, Herringer, and Williamson model method of computing the equivalent loan in year i .

O_i = total pre-tax cash operating costs expected to occur in year i if the firm purchases the asset but not if the asset is leased.

V_n = expected after-tax salvage value of the asset at the end of year n .

L_i = payment of principle and interest on a term loan in year i .

n = useful economic life of the asset in years (lease life).

t = corporate average and marginal tax rate on ordinary income.

t_i = investment tax credit rate.

K_i = after tax weighted average cost of capital for the firm.

r = pre-tax interest rate on intermediate-term debt.

$r_i = r(1-t)$, after-tax interest rate on intermediate-term debt.

p_i = after-tax cost of leasing (IRR model).

NAL = the NPV advantage of the lease.

(1) NPV Model

The conventional NPV model can be stated as follow.

$$\begin{aligned} \text{NAL} = & \sum_{i=1}^n \frac{L_i}{(1 + K_i)^i} - \sum_{i=1}^n \frac{R_i}{(1 + K_i)^i} - \sum_{i=1}^n \frac{tD_i}{(1 + K_i)^i} + \sum_{i=1}^n \frac{tR_i}{(1 + K_i)^i} \\ & - \sum_{i=1}^n \frac{tI_i}{(1 + K_i)^i} + \sum_{i=1}^n \frac{O_i(1 - t)}{(1 + K_i)^i} - \frac{V_n}{(1 + K_i)^n} - \frac{t_e A_0}{1 + K_i} \end{aligned}$$

From the above observe that an investment proposal's NPV is derived by discounting the cash receipts to their present values and summing them over the life of the proposal. One can assume that the firm will wish to maximize its wealth, and there exists perfect

certainty as to the elements of the above equation. Then the decision rules will be that when NAL is greater than zero, we lease the asset and when NAL is less than zero, we buy the asset. The present values are calculated using a discount cost which reflects the alternative use of capital, i.e., the opportunity cost which under uncertainty would be the riskless rate of interest. Thus, these decision rules should, under the assumed conditions, result in an optimal choice of financing that will increase the value of the firm.

(2) IRR Model

The traditional IRR model is another time-discounted measure of investment worth. As applied to the lease versus buy decision, the equation is as follows.

$$0 = A_0 - \sum_{t=1}^n \frac{R_t}{(1 + P_t)^t} - \sum_{t=1}^n \frac{tD_t}{(1 + P_t)^t} + \sum_{t=1}^n \frac{tR_t}{(1 + P_t)^t} + \sum_{t=1}^n \frac{O_t(1 - t)}{(1 + P_t)^t} \\ - \frac{V_n}{(1 + P_t)^n} - \frac{t_c A_0}{1 + P_t}$$

From the above equation, the IRR is defined as that rate of discount which equates the present value of the stream of net receipts with the initial outlay. The decision rules for the IRR model are the following. [Ref.24: p. 41-47]

1. Lease if the IRR exceeds the after-tax weighted average cost of capital for the firm.
2. Buy if the IRR is less than the after-tax weighted average cost of capital for the firm.

From the above two models, observe that if a buy decision is reached through the NPV criterion, the buy decision will also be reached by the IRR criterion, and vice versa. If the lease versus buy decision is not a separate decision from the decision as to whether to undertake a project, one must examine and evaluate the incremental cash flows at the firm's cost of capital. Then, the NPV method insures that the firm will reach the optimal scale of investment and is established in terms of a percentage rather than in terms of absolute dollars. However, one should be careful to note that despite the fact that both the NPV and IRR models result in the same lease and buy decisions, this equivalence does not necessarily hold for the ranking of investment proposals. This same problem arises in traditional capital budgeting decisions among mutually exclusive choice situations.

Also, assumptions as to reinvestment rates further differentiate between IRR and NPV in the lease versus buy decision. The reinvestment rate is the time-discounting process that underlies both the NPV and IRR methods. In the NPV method, it is assumed that all receipts can be reinvested at the firm's opportunity cost of capital or the firm's alternative use of funds. On the other hand, the IRR method assumes reinvestment at the project's rate of return. This latter assumption, however, has no economic basis since the alternative cost of capital may not be the project's rate of return and the after-tax weighted average cost of capital for the firm at the same time. The first reason the above could not occur is that high-return projects in the future may not be available as they are today. The second reason is that even if such projects were available, these projects will always be executed by a firm whose cost of capital is equal to K_1 in the NPV model independent of the decision on the current project under consideration. Thus, it is in error to credit the current project with any future benefits

accruing from the reinvestment of the interim proceeds at rates of return above K_i in the NPV model. Therefore, in deciding which lease versus buy model to use, one must remember that the NPV method provides an optimal solution to the generalized capital budgeting problem given the assumption that future cash flows and the appropriate cost of capital are known. Both the NPV and IRR are weighted average where the former method uses the appropriate short-term weights: K_1, K_2, \dots, K_n while the latter method uses the inappropriate long-term rate of return P . [Ref.25: p.73-79]

(3) *Lump Sum Loan Model (Bower, Herringer and Williamson)*

The third model of lease versus buy to be considered is the Lump Sum Loan model.

$$\begin{aligned} \text{NAL} = & A_0 - \sum_{i=1}^n \frac{R_i}{(1+r)^i} - \sum_{i=1}^n \frac{tD_i}{(1+K_i)^i} + \sum_{i=1}^n \frac{tR_i}{(1+K_i)^i} \\ & - \sum_{i=1}^n \frac{tI'_i}{(1+K_i)^i} + \sum_{i=1}^n \frac{O_i(1-t)}{(1+K_i)^i} - \frac{V_n}{(1+K_i)^n} - \frac{t_c A_0}{1+K_i} \end{aligned}$$

This method assumes that the firm's objective is to maximize its wealth and takes into consideration the lease-loan decision. Again, K_i is a weighted average cost of capital for the firm and the rate of return that a firm's investors expect. K_i also can be applied to basic cash flows associated with leasing to discover how the market value of the firm will be affected by the lease choice. Thus, the operating average of the lease can be measured. The non-cancellable claims included in the lease agreement can be capitalized at the rate that applies to debt. This rate is designated r and is used to determine the market value of the lease. Thus, the financial advantage of the lease is the difference between the market value of the lease and the loan that could replace that lease.

The model takes the rates K_1 and r as well as the optimal mix of debt and equity and relates them all to the risk in the firm's flows. According to the authors, the proper assumption is that a lease payment schedule of any configuration can be matched by a loan or series of loans with the same configuration. Thus, we adjust for our uncertainty by adjusting K_1 and r .

Also, of note is the fact that I_1' is calculated as follows for this model.

$$I_1' = X_{t+1} r$$

where

X = purchase price of the loan

$$X_{t+2} = [B_{(t+1)} - V_{(t+2)} r] \text{ for } i = 2 \text{ to } i = n$$

where B is the loan payments that are equivalent to the lease payments.

$$B_t = R_t \left(\frac{X_0}{E_0} \right)$$

where E is the market value of the lease.

$$E_0 = \sum_{t=1}^n \frac{R_t}{(1+r)^t}$$

The market value of the lease is defined as the sum of the lease payments discounted at the loan rate. The market value of the alternative loan is equal to the purchase price of the equipment that the loan would finance. [Ref.26: p.257-265]

The final decision will dictate that it is be leased if the NAL is positive and bought if the NAL is negative.

(4) Annual Installment Model (Weston and Brigham)

The last model to be considered is the Annual Installment model.

$$\begin{aligned} \text{NAL} = & A_0 - \sum_{i=1}^n \frac{R_i}{(1+r)^i} - \sum_{i=1}^n \frac{tD_i}{(1+K_i)^i} + \sum_{i=1}^n \frac{tR_i}{(1+K_i)^i} - \sum_{i=1}^n \frac{tI'_i}{(1+K_i)^i} + \sum_{i=1}^n \frac{O_i(1-t)}{(1+K_i)^i} \\ & - \frac{V_n}{(1+K_i)^n} - \frac{t_c A_0}{1+K_i} \end{aligned}$$

This model also takes into account the burden of financing a purchase if buy is the final decision in the lease versus buy decision. The first term on the right hand side of the equation differs from the first term of the right hand side of the equation in the Lump Sum Loan model in that the former assumes annual installments repaid whereas the latter considers a lump sum loan purchase in the first year. The rest of the equation's elements are fairly straight forward except for the following two points. Note first of all that I_i is computed directly from the loan payment for period i instead of the more complicated method in the Bower, Herringer, and Williamson model. Note also that all elements in the Annual Installment model, except salvage value considerations are discounted by the firm's after-tax debt rather than the after-tax weighted average cost of capital for the firm, as in the Lump Sum Loan model and the conventional NPV model. According to Weston and Brigham, in comparing two financial alternatives there is essentially no risk to the firm in obtaining the savings attributable to one alternative over the other. If this is the case, then, a discount rate that reflects the low risk is preferable to one that reflects the firm's average risk. [Ref.27: p.264-273]

A positive NAL result indicates that it is cheaper to lease rather than buy, and a negative result indicates that it is cheaper for the firm to borrow and purchase rather than lease.

b. Payback Analysis

Some organizations use payback analysis in their everyday lease versus buy decisions. The following discussion of this much maligned method is undertaken as a basic building block to the understanding of the lease versus buy subject. The payback period is defined as a measure of time it will take to recover the original investment from the resultant improvement in cash flows from earnings or savings. Firms that use this method establish a minimum acceptable payback period, e.g., such as a three year period. This period would then be the accept-reject criterion. If a firm then determined that an initial investment on a project will be recovered sometime in the fourth year of the project's life, the proposed project would fail to meet the established test.

Obviously, then, what this criterion does is favor those projects which return the largest benefits in the early years relative to the initial outlay. This result is desirable; however, weakness occur because this method fails to discriminate as to the timing of the cash flows and fails to account for the benefits which lie beyond the payback period. Thus, the payback criterion is not in fact a true measure of profitability.

Although payback analysis has declined relative to time-adjusted methods in capital budgeting, this method is still widely used in both industry and government. Familiarity, simplicity, and apparent objectivity are reasons for this consideration. Although the aforementioned criticisms do exist, they are diminished in importance if the comparisons of alternatives are among a family of investment opportunities having roughly the same economic life and profile of benefits. Thus, there is a rough similarity

with the true profitability established in the time-adjusted method in that both methods favor high cash flows in the early years. However, it is not wise to assume that a firm would accept an investment proposal that promised to return solely the initial investment. Thus, in practice a firm using the payback criterion would probably make a qualitative rather than quantitative decision regarding the cash flow in the years following the payback cutoff. [Ref.21: p.173-176]

Of further interest to the firm that is making capital budgeting decisions is the fact that the payback period can, under certain circumstances, provide a rough estimate of the investment proposal's rate of profit. Note, from the definition of the payback period, that the reciprocal of the payback period ($K = 1/\text{payback period}$) is the reciprocal estimate of the rate of profit. Therefore,

$$K = \frac{1}{\text{pay back period}} = \frac{S_t}{C}$$

where

K = the proposal's expected rate of profit

S_t = the earnings or savings before depreciation that the proposal is expected to provide in the year t

C = the cost of the proposal

n = the number of years the equipment is expected to last.

Then from our net present value formula, assuming S_t is constant overtime,

$$C = \frac{S}{K} - \frac{S}{K} \left(\frac{1}{1+K} \right)^n$$

where salvage value is assumed to be negligible, our rate of profit is

$$K = \frac{S}{C} - \frac{S}{C} \left(\frac{1}{1+K} \right)^n$$

From the above equation, the second term approaches zero as n, the life of the proposal, becomes infinitely large.

The above results yield the following conclusions.

1. If an equipment proposal will earn or save the same annual amount forever, its rate of profit is simply the reciprocal of its payback period.
2. If the equipment will last a finite number of years, the rate of profit is at most the reciprocal of the payback period and smaller by the quantity $S/C(1+K)^n$

Myron J. Gordon developed the above reasoning. Gordon also determined that the project life which yields extremely small errors between the true rate of profit and the payback reciprocal estimate of the rate of profit is two or three years greater than twice the payback period in a before tax situation. Further study also indicated that, in regards to tax and depreciation considerations, the payback reciprocal estimate is a good estimate of the true rate of profitability for a project life above the post tax payback period. [Ref.28: p.48-55]

After all the above factors have been considered, the final justification for using payback analysis probably lies in the realism of risk reduction rather than just profitability analysis. Many firms have little faith in mid-term and longer projections of the future. The payback analysis is in essence a crude measure of risk. If a firm has little confidence in demand forecasts, capital expenditure program projections, etc., there will be a natural inclination to measure the time it will take for an investment to return the original outlay in relation to some near-term payback criterion. Thus, indeed, the

payback standard can be considered as a rough measure of the level of confidence judgement.[Ref.21: p.176]

IV. A SPECIFIC EXAMPLE OF THE LEASE VERSUS BUY DECISION IN GOVERNMENT SECTOR

The purpose of this chapter is to discuss an example of a lease versus buy decision for a government transaction. Several assumptions will be set forth to clarify the example and demonstrate the elements of a decision and to give the reader an insight into the actual application of the previous chapter's discussions concerning the lease versus buy decision.

A. BACKGROUND

The case considered involves copiers obtained from the Canon U.S.A., Inc. for the General Services Administration (GSA) under contract number GS-OOF-91560. This example will define each option, examine technical and financial aspects in theory, outline a cost analysis obtained in the local area, and offer military considerations for lease versus buy decision-making.

This review will focus on the operating or service lease as it is the appropriate type lease for copiers. This is a short-term lease for considerably less than the life expectancy of the equipment. The lessee is provided with the equipment necessary to meet operational requirements and functional specifications. For copiers, this may include a specified number of copies per month; duplexing, enlarging/reducing and sorting capabilities; and required repairs completed in a specified minimum number of hours. The lessee's only right is to the service provided, not to any particular equipment.

B. FACTORS FOR CONSIDERATION IN THE LEASE VERSUS BUY ASSESSMENT

1. Technical Aspects

Technical aspects of lease versus buy decisions differ with the research and development required. Where major technologies must be developed, as in weapon systems, the buyer or lessee may be "locked in" to requirements years in advance of the actual fielding or use of the equipment. (In fact, the lessee is "locked in" earlier than the buyer.) [Ref.17: p. 27]

In the case of non-developmental items such as copiers, "state-of-the-art" technology exist on the shelf and the buy or lease is for what is currently available. The lease versus buy technical consideration for non-developmental items favors leasing, because it offers more flexibility for requirements' changes. For example, buying a copier based on today's technology and requirements in effect locks the buyer into that technology and its capability throughout the life of the copier. Whereas, a lease arrangement is normally renegotiated at the end of short-term lease period. At that time, requirements can be reevaluated and new technology that has emerged during the period can be considered. Therefore, technological advances can be incorporated more quickly in lease situation where non-developmental items are concerned.

2. Financial Aspects

There are two financial aspects to consider: cost and funding. First, in terms of cost, the dollar cost of a lease to the lessee agency or activity is usually cheaper than the purchase cost. Since the lessor owns the equipment, he is entitled to depreciation and capital investment tax incentives. Therefore, the lessor can make the lease price more attractive to the lessee activity. While this gives agencies such as the Department of

Defense (DoD) and their activities more bang for their buck, the Federal Treasury is denied an offsetting amount in tax revenues so that the overall net effect to the Federal Government is zero. This presents nothing more than a shift of cost from the leasing agency to the treasury and this point is not lost on the General accounting office. Nevertheless, DoD's parochial interests favor leasing.

Second, the funding aspects are determined by the dollar amount involved. In large dollar considerations, buys are funded by Other Procurement, Navy (OPN) dollars while leases are funded by Operations and maintenance Navy (O&MN) dollars. OPN funds must be budgeted well in advance in the Planning, Programming and Budgeting System (PPBS) process and come under considerable scrutiny during each year of PPBS cycle. This all boils down to the fact that it is "easier" in a funding sense to lease rather than buy. [Ref.17: pp. 31-32]

Table 1 summarizes the technical and financial aspects of lease versus buy.

Table 1. Lease Versus Buy Summary

LEASE	BUY
Short-term	Long-term
Flexible	Locked in
State-of-the-art	Aging
Small, periodic cash outflow	Large initial cash outflow
Funding easier (O&MN funds)	Funding harder (OPN funds)

C. COST ANALYSIS

The figures used in this cost analysis were obtained from the Canon U.S.A., Inc. price list for October 1, 1988 through September 30, 1989 for the General services Administration (GSA) contract number GS-OOF-91560. Copier suppliers (i.e., toner, paper, etc.) were not considered as factors in the analysis because the price and quantity projected were the same for the both lease and buy options.

The analysis was based on the net present value, using a ten percent discount rate, with all payments for the year being made on day one of that year. The copier used as representative was a Canon NP-4540 RDF system A model, producing 40,000 copiers per month. The purchase price of the copier was \$9360. There was no charge for installation and the copier was under a 90-day warranty. The full maintenance contract, begun after the warranty period, was \$248.83 per month for 20,000 copies and \$.009 per excess copy. The life of the copier was guaranteed for seven years or 2,340,000 copies. At a rate of 40,000 copies per month, the copier was guaranteed for 4.875 years (or four years ten and one-half months). The lease cost was \$544 per month for 20,000 copies and \$.009 per excess copy. Lessees were charged for installation and removal, and both charges were \$175. [Ref.29: p.36-37]

Table 2. shows the comparison of present value costs by year and option. As expected, the purchase option required a large initial cash outflow in year one. However, after year three the purchase option had drawn even with the lease option and showed a lower total cost at the end of the period.

Table 2. Present Value Cost Comparisons for Lease versus Buy Options

year	Buy Cost	Buy Cumulative	Lease Cost	Lease Cumulative
1	13,219.47	13,219.47	8,863.00	8,863.00
2	4,678.15	17,879.62	7,898.18	16,761.18
3	4,252.86	22,150.48	7,180.17	23,941.35
4	3,866.24	26,016.72	6,527.42	30,468.77
5*	3,075.42	29,092.14	5,311.80	35,780.57

* Year 5 includes only 10.5 months marking end of guaranteed life of purchased machine.

D. CONCLUSIONS

In summary, while technical and financial aspects must be considered in lease versus buy decision, operational aspects are paramount in the military environment. While the local cost analysis outlined clearly supports buying a copier, all decisions are not made on the basis of economic factors alone. Therefore, consideration should be given to the following factors which support leasing:

1. Maintenance

Control over copier maintenance is greater with a lease than purchase. If the copier is purchased and the quality of maintenance performed is unsatisfactory (though hard to document and prove), the only recourse is to withhold the monthly maintenance charge. This action, however, will void the guaranteed turn-in value of the copier. In a lease situation, two courses are available: (1) withhold the monthly lease payment (which is considerably more than the monthly maintenance fee) or (2) threaten to switch to another copier company at the end of the short-term lease period. The company will most likely provide better service to a lessee to cultivate good will toward lease renewal.

Additionally, if the copier company goes into bankruptcy or becomes insolvent in a buy situation, the buyer will have to obtain maintenance services from another company. This puts the buyer at a disadvantage in two ways: (1) the new company is aware of the buyer's need and can charge more money and (2) the time involved to negotiate a new contract can impact the mission of the command. (particularly at a Naval Telecommunications Center where copies are required seven days a week, 24 hours a day.) On the other hand, the lessee can more quickly negotiate a new lease at a competitive price because all options remain open.

2. Liability

If the copier suffers some major catastrophic failure and a dispute over its cause results (i.e., user abuse versus equipment malfunction), the buyer is in a more tenuous position than the lessee. The copier company will be more willing to fix its own machine (the leased one) and more willing to be taken to court over the government-owned machine. (surmising that the government will not waste the time and money on a court case.) Also, since the government is a self-insurer, there is no recourse for an insurance claim.

3. Equipment Disposal

At the end of the life of equipment, the buyer must be concerned with disposal. This may entail determination of the proper disposal, crating and shipping costs, recovery of precious metals (i.e., gold), and/or disposal of hazardous wastes (i.e., PCBs). The command is then faced with the original problem: to lease or buy copier services.

4. Operations

Because of short-term nature of a lease, leasing offers more flexibility for changing operational requirements and allows new technological advances to be incorporated more quickly. Buyers are locked in to both requirements and technology for the life of the equipment.

5. Budget

Buying equipment necessitates a large front end cash outflow that is often hard to accommodate in a command budget with competing interests. Alternatively, a short-term lease obligation allows for predictable, periodic cash flows.

While this case comes to no absolute conclusions on the lease versus buy question, it has highlighted a wide variety of considerations for the decision-making process in a military setting. In addition, a lease versus buy decision for the public sector is not only made on economic and statistical data, and the command should consider a number of factors on its possible situation.

V. THE APPLICATION OF LEASE VERSUS BUY DECISION IN THE KOREAN ARMY

This chapter will apply the lease versus buy decision model to the Korean Army by means of the previous chapters' methodologies. It will introduce a general methodology of lease versus buy decision and discuss several factors to be considered in a lease versus buy decision in the Korean Army.

A. GENERAL LEASE VERSUS BUY DECISION MODEL IN THE KOREAN ARMY

1. Proposed Methodology

The Korean Army's first issue to be considered in procurement of an asset is the budget. With private industry producing a number of new technologically advanced, convenient and expensive equipment, such as data processing equipment, computers and medical equipment, the Korean Army could take advantage of these things for useful military processes. In establishing efficient budget plans to efficiently use the budget, the Korean Army managers face a lease versus buy decision dilemma.

The Korean Army has been leasing a number of medium level computers under terms of operating leases as mentioned chapter I. The Korean Army is running short of this kind of computer and the demand for computers in the Korean Army is increasing significantly.

One of the most significant reasons for leasing computers, rather than buying them is that leasing does not require large cash outlays. In fact, the Government budget is very restricted and not easily redirected to purchase computers. So leasing computers

for the Korean Army is supported by budget considerations in lease versus buy decision considerations.

This large factor for the Korean Army can be overcome if a bank loan is possible. Equipment with very high prices can be purchased by installment payments if money is borrowed. Here is a potential case study which analyzes a lease versus buy decision if the Korean Army tries to acquire more computers next time.

The lease-loan decision in the government sector is reasonable to approach as a method of resource supply, which is a financing decision not an investment decision. In other words, after justifying a special acquisition and its need, managers can select whether to finance it with a direct purchase or a lease through a third party loan. A lease versus buy model that best contributes to this kind of situation is the Bower, Herring, and Williamson model. (See Chapter III.) The decision base of this model is to compare the present value between lease payment and the interest payment for outside bank financing. Also, the depreciation and investment tax credit effect should be considered for this decision.

The following three alternatives can be considered for the Korean Army: [Ref. 30: p.43-52]

1. The lessee's and lessor's rate of interest are the same and equal to 0%;
2. The lessee's and lessor's rate of interest are the same but equal to 20%;
3. When the lessee's and lessor's rate of interest are different.

At the same time, these assumptions are followed:

1. There is no lessee's tax and the lease company has t % tax;

2. Terminal value of the asset (computers) is zero;
3. The asset will be depreciated on a straight-line basis.

a. The Lessee' and Lessor's Rate of Interest Are the Same and Equal To Is 0 %

If the Korean Army purchases the asset with federal funds, the rate of interest is zero, and the lessee receives no tax benefit as a government facility, the equation from above is as follows.

$$C [B(n,i)] = I, \text{ or } C = \frac{I}{B(n,i)}$$

where, C : debt payment of principle and interest per year on buy-borrow

n : useful economic life of the asset

i : the rate of interest (discount rate)

B (n,i) : present value of an annuity of \$1 in arrears

I : cash purchase price

If the lessor's rate of interest is 0% and has a t% tax, after-tax lease revenue is as follows:

$$(1 - t) R [B(n,i)] = I [1 - (PVD) t] , \text{ or}$$

$$R = \frac{I [1 - (PVD) T]}{(1 - t) B(n,i)} ,$$

where, R : lease revenue of lease company per year

t : tax of lease company

PVD : present value of depreciation per dollar of cost

Therefore, if $R < C$, the Korean Army will use a lease. In other words, if

$$\frac{I [1 - (PVD) t]}{(1 - t) B(n,i)} < \frac{I}{B(n,i)}$$

For example, assume that the Korean Army is trying to consider lease versus buy decision with federal funds for computers in which the initial cash purchase price is 5,000,000,000 Wons, the useful economic life of the computers is 6 years, the tax rate of lessor is 70%, and the rate of interest is 0 %.

In this case, C is given by

$$\begin{aligned} C &= \frac{I}{B(n,i)} = \frac{5,000,000,000}{B(6, 0)} = \frac{5,000,000,000}{6} \\ &= 833,333,333.3 \text{ Wons} \end{aligned}$$

For the lessor,

PVD = 1, (PVD) t = 0.7, B(n,i) = 6, 1 - t = 0.3 . Therefore,

$$\begin{aligned} R &= \frac{I [1 - (PVD) t]}{(1 - t) B (n,i)} = \frac{5,000,000,000 (1 - 0.7)}{0.3 (40)} \\ &= 833,333,333.3 \text{ Wons} \end{aligned}$$

In this example, $C = R$. There is no difference between purchasing the system for 5,000,000,000 Wons and leasing computers and paying 833,333,333.3 Wons per year. Therefore, with the same rate of interest for both the lessee and lessor, and the other

assumptions listed above, there is not a meaningful difference between the lease versus buy decision.

To see this, from the above example consider:

1. Tax effect of depreciation

$$0.7 * 5,000,000,000 = 3,500,000,000 \text{ Wons}$$

2. Tax payment on lease revenue

$$833,333,333.3 * (1 - 0.3) * 6 = 3,500,000,000 \text{ Wons}$$

So lessor's tax effect of depreciation is offset by the tax payments on lease revenue. If the lessor receives an Investment Tax Credit (ITC) of 10%, R is calculated as follows:

$$(1 - 0.7) R (6) = 5,000,000,000 (1 - 0.7 - 0.1)$$

$$1.8 R = 1,000,000,000$$

$$R = 555,555,555.5$$

Lessor's minimum lease charge is 555,555,555.5 with the ITC effect. So leasing is more desirable than buying. This is a kind of leveraged lease which assumes ITC.

b. The Lessee's and Lessor's Rate of Interest Are the Same but Not Equal To 20%

If the rate of interest is 20% (the rest of the assumptions are the same),

C and R are calculated as follows:

$$C = \frac{I}{B(6, 0.2)} = \frac{5,000,000,000}{3.326}$$

$$= 1,503,307,276$$

$$R = \frac{I [1 - (PVD) T]}{(1 - t) B(6, 0.2)} = \frac{5,000,000,000 [1 - 0.2134 * 0.7]}{0.3 * 3.326}$$

$$= 4,262,477,450$$

So buying is more reasonable than leasing. When 10% ITC is included,

$$R = \frac{5,000,000,000 (1 - 0.7 * 0.2134 - 0.1)}{0.3 * 3.326}$$

$$= 3,761,375,025 \text{ Wons}$$

and buying is still more attractive than leasing.

c. When the Lessee's and Lessor's Rate of Interest Are Different

Assume that for the lessee : tax = 0, rate of interest = k. On the other hand, for the lessor: tax = t, rate of interest = r , in this case, the relationship between lessee and lessor is as follows:

$$\text{If } \frac{I}{B(n,k)} > \frac{I [1 - (PVD) * t]}{(1 - t) B(n,r)}$$

then a lease is more desirable than buying the system.

For example, if k = 0.1 , t = 0.7, then

r = (1 - 0.7) * 0.1 = 0.03 . Purchase versus lease can be compared as follows:

1. In the case of buying computers,

$$C = \frac{I}{B(n,k)} = \frac{5,000,000,000}{B(6,0.1)} = \frac{5,000,000,000}{4.355}$$

$$= 1,148,105,625 \text{ Wons.}$$

So lessee should pay 1,148,105,625 Wons annually with 10% rate of interest.

2. In the case of leasing assets,

$$R = \frac{I [1 - (PVD) t]}{(1 - t) B(n,r)} = \frac{5,000,000,000 [1 - 0.97439 * 0.7]}{(1 - 0.7) * 5.417}$$

$$= 978,176,417.5 \text{ Wons}$$

the after-tax net cost for lessor to get the assets is:

$$\text{Net cost} = 5,000,000,000 [1 - 0.97439 * 0.7]$$

$$= 1,589,635,000 \text{ Wons.}$$

When lessee's payment is 978,176,417.5 Wons, the present value of the lessor's after-tax revenue of lessor is:

$$\text{PV(Revenue)} = 978,176,417.5 * (1 - 0.7) * 5.417$$

$$= 1,589,634,496 \text{ Wons,}$$

which just covers the lessor's after-tax net cost. In conclusion, the minimum lease payment which lessor can accept is 978,176,417.5 Wons. The lessee would be willing to pay up to 1,148,105,625 Wons. Therefore, the range of lessee's lease payment is between a maximum of 1,148,105,625 Wons and a minimum 978,176,417.5 Wons. Both the lessee and lessor would accept a lease rate in this range.

As mentioned before, the Korean Army has considered that all of these examples of lease versus buy analyses are funded with pure annual budget. As a government facility, if the purchase was financed using loans from outside banking facilities, the Korean Army could have a favorable economic evaluation of purchases relative to leases. This would give the Korean Army more flexibility in its lease versus buy decision and possibly more savings in the use of its budget.

2. Several Factors To Be Considered In This Methodology

a. Budget

As mentioned in the previous chapter, the budget is one of the most important factors to be considered in lease versus buy decision. Because direct purchasing of highly technical equipment involves high initial costs, leasing allows the lessee small and periodic cash outflows. In small countries with limited defense budgets, such as the Republic of Korea, this point is very important, since small countries have difficulty increasing the annual defense budget. In the Korean Army, every procurement activity has been stuck in the planning and operation. In other words, all budget activities are very constrained within a limited annual federal budget. Potentially, for this lease versus buy model, the Korean Army can consider a loan from outside banking facilities. The lease-loan or lease-buy borrowing concept can be a good alternative and result in an efficient use of the budget for the Korean Army. Also, it will be a large political point in the Korean Army headquarters.

b. maintenance

Control over computer maintenance is also an important issue, because the Korean Army does not have enough maintenance technicians. Leasing is preferred to buying when considering the maintenance factor. If the computer is purchased and the quality of maintenance insufficient, the only remedy is to withhold the maintenance payments. In lease situations, withholding the monthly lease payment is possible and you can threaten to switch to another computer company at the end of the short term lease period. Therefore, the maintenance factor must be strongly considered in the lease versus buy decision.

c. Estimating Obsolescence (Terminal Value)

Estimation of the risk of obsolescence of computers is often the most significant step in reaching a lease versus buy decision. The estimate involves:

1. Judging how long the contemplated equipment will serve the Korean Army's expected needs.

2. Appraising the likely effects on the Korean Army of the development of (a) improved equipment that can perform present and planned additional tasks far more rapidly or far less expensively than available equipment or (b) equipment that will allow the company to undertake profitably more extensive or entirely new applications of computers which are not currently anticipated.

Another key question is not whether the equipment is technically obsolete, but whether it is functionally obsolete for the Korean Army, or when it will be. The life of an entire configuration of equipment cannot be appraised intelligently as a whole. Each component, and its relation to the other components, needs individual consideration. Estimating the life of equipment, component by component, is the most important factor in reaching sound lease versus buy decision. [Ref.31: pp. 94-95]

d. Technical Changes

The problem of deciding how long a computer can be used advantageously is not an easy one. It is complicated by the need to consider the effects of future changes in workload and system requirements, the impact of improvements in technology, and potential long-term use of the computer elsewhere in government after its original purpose is served. All these considerations involve judgement. Either decision - buy or lease - resulting from these judgements can be costly if it turns out to be incorrect. If a leased computer is used beyond the break-even point, unnecessary

lease costs will be incurred. If a purchased computer cannot be used until the break-even point is reached, a loss on disposal is likely to occur.

Technical advances bring about significant reductions in cost and increases in operating effectiveness, and rental gives the user greater flexibility in changing computers as advances are made. But there are instances where computer with higher utilization rates will reach the purchase break-even point so quickly that there is little likelihood of a significant advance occurring in such a short period of time. [Ref.31: p.95-96]

B. CONCLUSION

A lease versus buy methodology for the Korean Army procurement in which A lease is assumed to be a viable alternative to purchase can be briefly expressed as follows:

1. Assign all recurring cost into operating costs, if the purchase decision were to be made, and lease payments, if the lease decision were to be made.
2. Establish a single purchase price if the purchase is to be the final decision in procurement.
3. Establish a realistic salvage value, if applicable, for the end of the anticipated life span.
4. Use the Lump Sum Loan model as set forth in the previous chapter. It largely depends on lessee's and lessor's rate of interest.
5. Compare payments between lease and buy.

However, final choices in lease versus buy analysis cannot be concluded by cost considerations. There are a number of factors involving environmental constraints, such

as the Korean Army's policies, annual budget, availability of maintenance, technical sophistication, etc. If all these constraints are included in the lease versus buy decision, the Korean Army managers can make efficient decisions to minimize annual budget expenditures.

APPENDIX A: LIST OF ABBREVIATIONS AND ACRONYMS

ERTA	Economic Recovery Tax Act
GSA	General Services Administration
IRR	Internal Rate of Return
IRS	Internal Revenue Service
ITC	Investment Tax Credit
NAL	the NPV Advantage of the Lease
NPV	Net Present Value
PBBS	Planning Programming and Budget System
PVB	Present Value of the Benefit
PVC	Present Value of the Cost
TEFRA	Tax Equity and Fiscal Responsibility Act

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